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OF

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FOR

COSMETIC APPLICATOR

[001] This application claims the benefit under 35 U.S.C. § 119(e) of U.S. Provisional Application No. 60/460,879, filed on April 8, 2003.

[002] The present invention relates to an applicator for applying a cosmetic product (where the term "cosmetic product" includes care products as well as other products, such as makeup, for example). In particular, various exemplary embodiments of the invention relate to an applicator for a nail varnish and/or mascara.

[003] There are various applicators for applying cosmetic products to nails or eyelashes, that include a mixture of different bristles. For example, European Patent Application No. EP 0 556 081 discloses a brush for applying a varnish to nails, where the brush comprises a mixture of bristles of different diameters.

[004] European Patent No. EP 0 239 270 describes a mascara brush that combines flexible bristles and stiff bristles so as to increase the amount of mascara that can be picked up and to improve combing of the eyelashes.

[005] European Patent Application No. EP A 0 651 955 discloses a brush for applying a varnish to nails. The brush comprises two sets of bristles having different mechanical properties in order to form relatively large spaces between the bristles and to retain a larger quantity of varnish.

[006] U.S. Patent No. 5,161,554 discloses a mascara brush comprising bristles having a cross-section, the diameter of which alternates between a larger diameter and a smaller diameter over the entire length of the bristles.

[007] However, there still exists a need to further improve the performance of a cosmetic applicator, in particular, with respect to the amount of cosmetic product to be carried by the applicator, while still allowing the applicator to be reliable and simple to

manufacture. There also exists a need for a cosmetic applicator that is capable of applying substances having a variety of viscosities.

[008] Although the present invention may obviate one or more of the above-mentioned needs, it should be understood that some aspects of the invention might not necessarily obviate one or more of those needs.

[009] In the following description, certain aspects and embodiments will become evident. It should be understood that the invention, in its broadest sense, could be practiced without having one or more features of these aspects and embodiments. It should be understood that these aspects and embodiments are merely exemplary.

[010] In one aspect, as embodied and broadly described herein, the invention includes an applicator for applying a cosmetic product (e.g., nail varnish or mascara), comprising a plurality of applicator elements (e.g., bristles and/or teeth). The plurality of applicator elements may comprise at least two applicator elements. Each of the at least two applicator elements may comprise at least one periodic pattern. The at least one period pattern may comprise at least one undulation, and at least two periodic patterns of the applicator elements may be different from one another.

[011] Another aspect of the invention may include an applicator for applying a cosmetic product, comprising a plurality of bristles. The plurality of bristles may comprise at least two bristles. Each of the at least two bristles may comprise at least one periodic pattern, wherein at least two periodic patterns of the bristles may be different from one another.

[012] Still another aspect of the invention may include an applicator for applying a cosmetic product, where the applicator may comprise at least two bristles, each comprising at least one undulating portion. The undulating portions of the two bristles may differ from

each other in at least one of their shapes, frequencies, and amplitudes. At least one of the undulating portions may present a pattern that may repeat periodically.

[013] As used herein, the term "periodic pattern" is intended to designate a portion of an applicator element (e.g., a portion of a bristle), where the portion is substantially reproduced in a periodic manner along the applicator element.

[014] A periodic pattern comprising at least one undulation may be characterized by three components, namely its shape (e.g., sinusoidal or sawtooth), its amplitude (i.e., its size measured in a direction orthogonal to the general longitudinal direction of the applicator element), and its spatial frequency (i.e. the number of patterns reproduced per unit length of the applicator element). The same pattern may be repeated several times over the entire length of the applicator element. Alternatively or additionally, an applicator element may comprise a single pattern or less than a single pattern.

[015] According to an aspect of the invention, the length of a periodic pattern may substantially correspond to the length of the applicator element. In that case, the shape of the pattern may be defined by a periodic function, such as, for example, a sinusoidal function or a sawtooth generator. By way of example, a bristle having a length of a periodic pattern may be made from a fiber of greater length having a number of periodic patterns by cutting the fiber into smaller pieces constituting the periodic pattern. The manufacture of such a bristle may be made easier by the fact that the pattern may repeat periodically.

[016] For example, when the applicator element is a bristle, a periodic pattern may also comprise at least one portion having a rough surface which may be associated, for example, with one or more fillers in the bristle material or on its surface. Alternatively or additionally, the bristle may comprise one or more notches. The periodic pattern may be

characterized by the frequency and/or the shape of the notches, or by the frequency and/or the distribution per unit area of the fillers within a given pattern.

[017] According to another aspect of the invention, a periodic pattern may also be formed by periodically varying the cross-section of the bristle along its length.

[018] In still another aspect, a periodic pattern of a bristle may comprise at least one undulation, and/or at least one filler, and/or at least one variation in the cross-section of the bristle, and/or at least one notch, and/or at least one relief portion.

[019] Some embodiments may facilitate formation of spaces between applicator elements (e.g., bristles), which may make it easier to retain substance by capillarity, compared to bristles formed entirely of rectilinear shape or of the same pattern. This may improve the amount of substance the applicator can retain, thus enabling a user to apply the substance on, for example, the nails in a single layer of sufficient thickness.

[020] When at least some embodiments are used with a wiper, the applicator may retain more substance between the applicator elements (e.g., bristles), while passing through the wiper, than an amount of substance that an applicator having bristles formed entirely of rectilinear shape or of the same pattern may retain.

[021] In another aspect of the invention, by having the periodic patterns and/or undulating portions, the applicator elements may possess a greater flexibility than applicator elements that are purely rectilinear.

[022] In some embodiments, the distribution of the free ends of bristles having different periodic patterns may be made more uniform.

[023] In another aspect of the invention, two different periodic patterns may belong to two distinct bristles. For example, the two different periodic patterns may

comprise at least one periodic pattern of one bristle and at least one periodic pattern of another bristle distinct from said one bristle.

[024] In still another aspect of the invention, two different periodic patterns may belong to the same bristle. For example, the two different periodic patterns may be periodic patterns of the same bristle.

[025] In yet still another aspect of the invention, different periodic patterns may present undulations of different shapes. For example, each of the at least two different periodic patterns may comprise at least one undulation having a shape that is different from a shape of at least one undulation of another of the at least two different periodic patterns. In an exemplary embodiment, one of the at least two different periodic patterns may comprise a sawtooth shape, while another of the at least two different periodic patterns may comprise a sinusoidal shape.

[026] According to another aspect of the invention, different periodic patterns may also present undulations of different amplitudes. For example, each of the at least two different periodic patterns may comprise at least one undulation having an amplitude that is different from an amplitude of an undulation of another of the at least two different periodic patterns.

[027] In still another aspect, the patterns may be of the same shape. For example, both of the two different periodic patterns may be a sawtooth shape or a sinusoidal shape. The patterns may also be of different shapes. The patterns may or may not have the same spatial frequency.

[028] The amplitude of a pattern may range from 20 micrometers (μm) to 3 millimeters (mm), for example.

[029] In yet still another aspect of the invention, the different periodic patterns may comprise undulations of different spatial frequencies. For example, each of the at least two different periodic patterns may comprise at least one undulation having a spatial frequency that is different from a spatial frequency of an undulation of another of the at least two different periodic patterns. Such patterns may comprise undulations of the same shape and/or amplitude.

[030] The spatial frequency of a pattern may range from 1/24 to 1/4 of a pattern per millimeter of bristle, for example.

[031] In another aspect of the invention, two different periodic patterns may comprise undulations of different shapes, amplitudes, and spatial frequencies. Alternatively, the two periodic patterns may differ only in one or two of the shapes, amplitudes, and spatial frequencies.

[032] According to still another aspect of the invention, the applicator may include more than two sets of bristles with different periodic patterns, and the proportion of bristles presenting the same pattern may vary to a large extent. For example, the applicator may comprise 50% bristles with a first pattern and 50% bristles with a second pattern that is different from the first pattern.

[033] Other distributions are also possible. For example, 1% to 99% of the bristles may comprise the same periodic pattern. In some embodiments, 20% to 80% of the bristles may comprise the same periodic pattern. For some embodiments, 30% to 60% of the bristles may comprise the same periodic pattern. These values are intended to be exemplary rather than limiting.

[034] In another aspect of the invention, the applicator may include at least one bristle comprising at least one rectilinear portion. Alternatively or additionally, the applicator may include at least one bristle that is entirely rectilinear.

[035] In another aspect, the applicator may include at least one bristle comprising at least one rectilinear portion and at least one periodic pattern comprising at least one undulation.

[036] In still another aspect, at least one of the bristles may comprise a plurality of periodic patterns along its entire length.

[037] In yet still another aspect, the applicator may include at least two bristles of different lengths. For example, at least two of the bristles may comprise lengths different from one another.

[038] According to an aspect of the invention, at least one of the bristles may comprise a twisted bristle, at least over a fraction of its length.

[039] By way of example, the applicator may include bristles of diameter ranging from 0.05 to 0.4 millimeter.

[040] In another aspect of the invention, the applicator may include at least two bristles of different diameters. In other words, one of the bristles may have a diameter that is different from a diameter of another of the bristles.

[041] In accordance with still another aspect, at least one of the bristles may comprise a circular cross-section. Alternatively or additionally, at least one of the bristles may comprise a non-circular cross-section. When the bristle does not have a circular cross-section, the term "bristle diameter" is used to mean the diameter of the circle circumscribing the largest cross-section of the bristle.

[042] In yet another aspect of the invention, the bristles may be made of synthetic material. For example, the bristles may comprise a thermoplastic material, such as a thermoplastic elastomer. In another aspect, at least one of the bristles may comprise a natural fiber.

[043] In still another aspect, the bristles may be of different kinds. For example, the bristles may comprise at least two different kinds of bristles, such as, for example, bristles made out of materials having different vitreous transition temperatures.

[044] In yet still another aspect, the bristles may comprise cross-sections that are solid or hollow, circular or non-circular, or constant or non-constant. For example, at least one of the bristles may comprise a hollow or solid cross-section. Alternatively or additionally, at least one of the bristles may comprise a constant or non-constant cross-section along the length of the bristle. In an exemplary embodiment, at least one of the bristles may comprise an alternating cross-section along the length of the bristle between sections of a larger diameter and sections of a smaller diameter. The bristles may optionally carry a coating of flocking.

[045] As mentioned above, the bristles may also include a filler over their entire length or over a fraction of the length. Such a filler may include, but be not limited to, a magnetic compound, a moisture-absorbing compound, a compound for creating roughness at the surface of the bristle, a compound for improving sliding, or any combination thereof. The filler may be distributed in such a manner as to create a periodic pattern.

[046] In an aspect of the invention, the applicator may constitute a brush, such as a mascara brush. In some embodiments, the undulating bristles may make it possible to obtain a distribution of the free ends of the bristles along the length of the brush that may be more uniform than that of rectilinear bristles.

[047] For some embodiments, undulating bristles may cross one another (e.g., when the applicator is viewed in a direction perpendicular to its axis) so as to increase the amount of substance that can be picked up by the bristles and to improve the combing of, for example, eyelashes or eyebrows, where appropriate.

[048] In still another aspect, the brush may comprise a twisted core supporting the bristles. The bristles may be made in a manner other than that involving injection-molding bristles together with a core (e.g., by making the bristle by injection molding before securing them to the core). In yet another aspect, the bristles may be secured to the brush by a suitable securing mechanism, such as adhesion, stapling, overmolding, or any other mechanism known in the art. In a variant, the bristles may be secured to the brush by stamping a support. In another variant, the bristles may be secured to the brush in a row. The brush may be arranged to pick up substance from a cake of substance. The bristles may extend only from one side of a support.

[049] According to another aspect of the invention, an envelope surface of the brush may comprise a variety of different cross-sectional shapes. For example, the cross-sectional shapes may be substantially circular, oval, or polygonal, and/or include one or more notches or indentations.

[050] In still another aspect of the invention, the core may be centered or off-centered relative to a cross-section of the envelope surface. In yet still another aspect, the cross-section of the envelope surface may be constant or non-constant over at least a fraction of the length of the brush. Alternatively or additionally, at least portion of the brush may comprise a cross-section that passes through an extremum between its two axial ends, said extremum being a maximum or a minimum, for example.

[051] In another aspect of the invention, the core may be rectilinear. Alternatively, at least a portion of the core may be curved. For example, the curvature may be distributed over the entire length of the core or may be localized only in a portion where the brush is fixed to a stem of an applicator. Where appropriate, the brush may be curved about at least two axes that are not coplanar.

[052] With a twisted core, the brush may comprise 5 to 60 bristles per turn, for example. The number of bristles per turn may correspond to the number of bristle ends that may be counted by a stationary observer while turning the brush 180° about its core.

[053] In another aspect of the invention, the length of the bristles may range from 1 mm to 7 mm. In still another aspect, the length of the bristles may range from 2 mm to 5 mm.

[054] In another aspect of the invention, the applicator may be in the form of a paint brush (e.g., with bristles extending from a stem in a direction substantially parallel to an axis of the stem), such as a brush for applying varnish to nails. Under such circumstances, the applicator may comprise a stem to which a bundle of bristles may be fixed. The stem may comprise a housing at an end portion of the stem, so that the bristles may be fixed to the stem by at least one of adhesion, stapling, and overmolding,for example. The housing may alternatively or additionally comprise a cross-section that is oblong along a transverse axis of greater length.

[055] In still another aspect of the invention, the housing may comprise a cross-section that tapers towards its inside end. This tapered portion may correspond to a flare for the bristles. The end wall of the housing may include a setback in which the bristles may be secured. The setback may comprise a flared portion that opens out towards its

opening, so as to enable the bristles to splay apart from one another in order to confer an enlarged shape on the bundle.

[056] In yet still another aspect of the invention, the housing may be arranged in such a manner that the bristles may extend outside the housing over a predetermined distance, where the distance may be measured parallel to the above-mentioned transverse axis. In various exemplary embodiments, the length of the portion of the bristles extending outside the housing in the stem may range from 5 mm to 20 mm, for example.

[057] In accordance with an aspect of the invention, the free ends of the bristles may substantially define an arc of a circle having a radius of curvature ranging from, for example, 2 mm to 15 mm. In another aspect, the radius of curvature may range from 4 mm to 10 mm.

[058] In still another aspect, the width of the opening in the housing, measured perpendicularly to the above-specified transverse axis, may be less than or equal to, for example, 2 mm.

[059] In another aspect, the invention may include a device for applying a product (e.g., a nail varnish) to nails. The device may comprise a receptacle containing a nail product to be applied, and an applicator as defined above.

[060] In still another aspect of the invention, the greater transverse dimension of the portion of the stem immersed in the product contained in the receptacle, when the applicator is in place thereon, may be less than or equal to 5 mm.

[061] In yet another aspect of the invention, the stem may be arranged for fixing to a closure cap of the receptacle. Alternatively, the stem and the closure cap may be integrally formed as a single piece via, for example, molding from a suitable material, such as a plastics material.

[062] Another aspect of the invention may include a device for applying a product to at least one of eyelashes and eyebrows. For example, the device may comprise a receptacle containing an eyelash and/or eyebrow product to be applied, and the applicator as defined above. Where appropriate, the device may further comprise a wiping member configured to wipe the applicator.Still another aspect of the invention may include a method of applying a cosmetic product. The method may comprise providing the applicator as defined above, and applying the cosmetic product using the applicator. The product may be a nail varnish or a mascara.

[063] The term "providing" is used in a broad sense, and refers to, but is not limited to, making available for use, enabling usage, giving, supplying, obtaining, getting a hold of, acquiring, purchasing, manufacturing, selling, distributing, possessing, making ready for use, and/or placing in a position ready for use.

[064] Aside from the structural and procedural arrangements set forth above, the invention could include a number of other arrangements, such as those explained hereinafter. It is to be understood, that both the foregoing description and the following description are exemplary.

[065] The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate a number of non-limiting embodiments of the invention and together with the description, serve to explain the principles of the invention.

[066] Fig. 1 is an axial, partial cross-section view of a device for applying a substance to, for example, nails, according to an exemplary embodiment of the invention.

[067] Fig. 2 is a diagram showing an example of an undulating portion of a bristle.

[068] Fig. 3 is a diagram showing an exemplary undulating portion having a shape that is different from the shape of the undulating portion of Fig. 2.

[069] Fig. 4 is a diagram showing two undulating portions with patterns of the same shape, but of differing amplitudes and spatial frequencies.

[070] Fig. 5 is a diagram showing two undulating portions with patterns of the same shape, but of differing spatial frequencies.

[071] Fig. 6 is a diagram showing two undulating portions with patterns having differing shapes from one another.

[072] Fig. 7 is a diagram showing three bristles, where one of the bristles comprises a rectilinear portion and the other two comprise undulating portions.

[073] Fig. 8 is a diagram showing two undulating portions made of bristles of different diameters.

[074] Fig. 9 is a diagram showing the end of a brush made of bristles of different diameters.

[075] Fig. 10 is a diagram showing a bristle comprising two undulating portions with differing frequencies and amplitudes.

[076] Fig. 11 is a diagram showing a portion of a bristle comprising a rectilinear portion and an undulating portion.

[077] Fig. 12 is a diagram showing a portion of a bristle that is undulating and twisted.

[078] Fig. 13 is a cross-sectional view of the bristle of Fig. 12 along the XIII-XIII plane.

[079] Fig. 14 is a diagram showing a portion of a bristle comprising a notch periodic pattern.

[080] Figs. 15 to 17 are diagrams showing portions of bristles, illustrating other various examples of periodic patterns.

[081] Figs. 18 to 21 are diagrams showing various examples of pairs of bristles having differing periodic patterns.

[082] Fig. 22 is a diagram showing a distal end portion of a brush for applying a substance, where the brush is made in accordance with an exemplary embodiment of the invention.

[083] Figs. 23 and 24 are diagrams illustrating exemplary variants of the brush shown in Fig. 22.

[084] Figs. 25 to 27 are cross-sectional views of various exemplary embodiments of a bristle bundle in an applicator.

[085] Figs. 28 and 29 are partial cross-sectional views of a brush, illustrating various exemplary embodiments of a housing in which the bristles of a brush may be secured.

[086] Figs. 30 and 31 are schematic illustration showing how bristles may be secured to a stem of an applicator by a staple, according an exemplary embodiment of the invention.

[087] Fig. 32 is a schematic illustration of how bristles may be secured to a stem of an applicator, according another exemplary embodiment of the invention.

[088] Fig. 33 is an axial, cross-sectional view of an applicator and packaging device for a substance for application to eyelashes and/or eyebrows.

[089] Fig. 34 is an end view of the brush shown in Fig. 33, as seen in the direction of the arrow XXXIV.

[090] Fig. 35 is a diagrammatic and fragmentary view showing the bristles held between the twisted branches of the brush core shown in Fig. 33.

[091] Fig. 36 is a diagram illustrating an exemplary variant of the brush shown in Fig. 34.

[092] Figs. 37 to 47 are diagrammatic cross-sectional views of exemplary embodiments of a brush envelope, illustrating various possible shapes.

[093] Fig. 48 is a schematic diagram illustrating how a core of a brush may be off-centered.

[094] Fig. 49 is a diagram showing an exemplary embodiment of a dual core (bristles not shown).

[095] Figs. 50 to 66 are schematic cross-sectional views of various examples of bristles.

[096] Figs. 67 to 71 are diagrams showing distal end portions of various examples of bristles.

[097] Fig. 72 is a diagrammatic and fragmentary cross-section view of an applicator comprising undulating teeth with different periodic patterns.

[098] Reference will now be made in detail to the exemplary embodiments of the invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts. It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention, as claimed.

[099] Fig. 1 shows a device 1 for packaging and applying a substance (e.g., a nail varnish V) to a body portion, such as, for example, a nail or hair. The device 1 may comprise a receptacle 2 containing the varnish V and an applicator 3 constituting a brush. The applicator 3 may comprise a handle member 10, a rectilinear stem 4 extending from

the handle member 10 along a longitudinal axis X, and a bundle of bristles 5 fitted proximate the end of the stem 4. The handle member 10 may also constitute a closure cap for the receptacle 2.

[0100] As shown in Fig. 1, the receptacle 2 may contain a ball 6, such as, for example, a metal ball, which may enable the varnish V to be more uniformly mixed prior to application by shaking the device 1.

[0101] The stem 4 may be made of, for example, a plastic material and may include a skirt 8 at its top end for securing the stem 4 to a housing of the handle member 10. The handle member 10 may be configured to engage with the neck 11 of the receptacle 2 via a suitable mechanism known in the art, such as, for example, a thread fitting, an interference fitting, or a snap-fastening. A collar 12 may be formed at the base of the skirt 8 so as to bear against the top end edge of the neck 11 when the applicator is positioned in place on the receptacle 2.

[0102] In the exemplary embodiment shown in Fig. 1, the stem 4 may comprise a conical portion 13 beneath the collar 12, which may be configured to seal the receptacle 2 in a closed condition when the applicator 3 is positioned in place thereon. Sealing may also be obtained by cooperation between surfaces of the handle member 10 and of the neck 11 of the receptacle 2. Alternatively or additionally, any other sealing mechanisms known in the art may be used.

[0103] The stem 4 may also include a bottom end portion 14 which may be provided with a housing 15 (not visible in Fig. 1, but shown in Figs. 28-31), within which the bristles 5 of the brush may be secured.

[0104] In accordance with an aspect of the invention, the bundle of bristles 5 may comprise at least two undulating portions of different patterns.

[0105] Fig. 2 shows an undulating portion 20 of a bristle comprising a plurality of identical periodic patterns. More precisely, the bristle comprises three identical periodic patterns, where each of the period patterns has a sinusoidal shape. Each periodic pattern in Fig. 2 may be defined by the portion between two vertical dashed lines. One undulation portion 20 may correspond to succession of at least one indented portion in relief and one projecting portion in relief.

[0106] A periodic pattern of an undulation may be defined by its shape, amplitude *a*, and/or spatial frequency (i.e. the number of patterns per unit length of bristle).

[0107] In another aspect of the invention, the pattern may comprise any shape other than a sinusoidal shape. For example, the pattern may be of sawtooth shape, as shown in Fig. 3. For a sawtooth pattern, for example, the amplitude *a* may range, for example, from 20 μm to 3 mm, the spatial frequency may range, for example, from 1/24 to 1/4 of a periodic pattern per millimeter, and the length may range, for example, from 1 mm to 24 mm or from 4 mm to 24 mm.

[0108] Fig. 4 shows two undulating portions 20 with patterns of the same shape, but of differing amplitudes and spatial frequencies. By this exemplary arrangement, spaces 21 may be formed between the undulating portions 20. These spaces 21 may serve to retain substance by capillarity when the user withdraws the applicator 3 from the receptacle 2.

[0109] The undulating portions 20 with differing patterns may also enable a bundle of bristles 5 to be spaced out more widely, so as to facilitate picking up of a substance.

[0110] According to another embodiment, the undulating portions 20 may comprise at least two undulating portions 20 with patterns of the same shape, but of differing spatial frequencies. For example, as shown in Fig. 5, the two undulating portions 20 may have the

same sawtooth shape with the same amplitude, but with differing spatial frequencies. This exemplary arrangement may also form a plurality of spaces 21 between the undulation portions 20, serving as to retain a substance in the same manner described above with reference to the embodiment shown in Fig. 4 .

[0111] In still another exemplary embodiment of the invention, one of the two undulating portions 20 may have a shape that is different from a shape of the other of the two undulating portions 20. For example, as shown in Fig. 6, one of the two undulating portions 20 may comprise a sawtooth shape, while the other of the two undulating portions 20 may comprise a sinusoidal shape.

[0112] All of the bristles in a bundle 5 may comprise one or more undulating portions. Alternatively, as a variation from the embodiments shown in Figs. 4-6, the bundle 5 may also include one or more bristles 23 having a rectilinear portion 23, as shown in Fig. 7.

[0113] The undulating portions 22 may be made by extruding a fiber through a die having a diameter smaller than a diameter of the fiber and/or bringing the fiber into contact with one or more profiled rollers (e.g. in the form of gearing).

[0114] According to another exemplary embodiment of the invention, one or more of the bristles in a bundle 5 may have a diameter that is different from a diameter of other bristles in the bundle, as shown in Fig. 8. Fig. 9 is a cross-sectional view through, or an end view of, a bundle of bristles 5 having a combination of smaller-diameter bristles and larger-diameter bristles. By way of example only, the smaller-diameter bristles may have a diameter of 0.05 mm, and the larger-diameter bristles may have a diameter of 0.4 mm.

[0115] While an undulating portion 20 of a bristle may extend over the entire length of the bristle, or only over a fraction of its length, a single bristle may comprise a plurality of

undulating portions 20 of different patterns. For example, as shown in Fig. 10, a single bristle may comprise two undulating portions 20a and 20b having different patterns with the same shape (i.e., a sinusoidal shape), but with differing amplitudes and spatial frequencies. It should be understood that the patterns of two undulating portions 20a, 20b in a single bristle may alternatively or additionally differ in their shapes, amplitudes, and/or frequencies, as if they were two distinct bristles.

[0116] As another exemplary embodiment, Fig. 11 shows a single bristle comprising both a rectilinear portion and an undulating portion.

[0117] Alternatively or additionally, the bristle may be both undulating and twisted simultaneously, as shown in Fig. 12. In still another exemplary embodiment, as shown in Figs. 12 and 13, a bristle of non-circular cross-section may include a capillary groove 22. In this exemplary embodiment, the bristle may be twisted so that the capillary groove 22 may form a helix along the length of the bristle.

[0118] According to still another embodiment of the invention, a periodic pattern in a bristle may be defined by a portion of the bristle that repeats in a periodic manner. For example, as shown in Fig. 14, the pattern may correspond to a portion of a bristle (i.e., a portion between two dashed vertical lines) including a notch 100, where the bristle is marked at regular intervals with the notches.

[0119] A periodic pattern may also be defined by a portion of a bristle having a variable cross-section. For example, as shown in Fig. 15, a periodic pattern may be defined by a portion between two dashed vertical lines, in which the cross-section 101, 102 of the bristle alternates between a larger cross-section 102 and a smaller cross-section.

[0120] In another exemplary embodiment, the periodic pattern may be defined by a certain distribution of filler particles 103, as shown in Fig. 16. Similar to the other

embodiments described above with reference to Figs. 14 and 15, the distribution of filler particles 103 may repeat substantially at regular intervals along the length of the bristle.

[0121] Still another exemplary embodiment of the invention may provide a bristle comprising an undulating portion with filler particles 103 disposed at regular intervals, as shown in Fig. 17.

[0122] Figs. 18-21 show various exemplary embodiments of a pair of bristles having different patterns, in which at least one of the bristles comprises a notch and/or filler pattern. For example, in an embodiment shown in Fig. 18, the two bristles may comprise a rectilinear bristle having regular notches 100 and a bristle having an undulating portion 20. In an exemplary embodiment shown in Fig. 19, one of the undulating portions may include a filler that is distributed in a periodic manner. Fig. 20 shows the possibility of mixing bristles comprising undulating portions with or without notches 100. Fig. 21 shows the possibility of mixing bristles comprising undulating portions with notches disposed differently on the bristles.

[0123] According to another exemplary embodiment of the invention, the length of the bristles in a bundle 5 may be selected in such a manner that the free ends of the bristles may align substantially in a common plane perpendicular to the longitudinal axis X of the stem 4, as shown in Fig. 22. In a variant, the free ends of the bristles in the bundle 5 may be situated on a surface C that is not flat plane perpendicular to the longitudinal axis X of the stem 4. Instead, the surface C may form a convex plane going away from the stem 4, as shown in Fig. 23, or any other desired shapes. In another variant, as shown in Fig. 24, the free ends of the bristles of the bundle 5 may be situated substantially along a surface extending obliquely relative to the axis X of the stem 4.

[0124] The bundle 5 of bristles may present different cross-sectional shapes. As shown in Fig. 25, the brush may be flat, and the cross-section of the bundle 5 may be substantially rectangular. Alternatively, the brush may be round. For example, the cross-section of the bundle 5 may be circular, as shown in Fig. 26, or curved, as show in Fig. 27, so as to better conform to a shape of a round body portion, such as a nail. It is to be understood that the bundle 5 of bristles may form any other shape and/or cross-section (e.g., a shape and/or cross-section) depending on the shape of the body portion for which the bundle is intended to be used).

[0125] As shown in Figs. 28 and 29, the stem 4 may include a housing 15 for securing the bundle 5 therein. The housing 15 may have a constant cross-section, as shown in Fig. 28, thus making it possible, for example, to obtain a brush with bristles that are relatively tight. Alternatively, the cross-section of housing 15 may have a shape that diverges towards the distal end. By this arrangement, the bristles 5 may spread apart to a greater extent from one another so as to form a broader bundle of bristles, as shown in Fig. 29. In various exemplary embodiments, the length ℓ of the portion of the bristles extending outside the housing 15 may range from 5 mm to 20 mm, for example.

[0126] In another aspect, the bristles of the bundle 5 may be secured to the housing 15 by at least one of stapling, adhesion, melting, or overmolding.

[0127] As an example, a method of securing the bundle 5 to the housing 15 by stapling is described herein with reference to Figs. 30 and 31. As shown in Fig. 30, a staple 30 may engage the bristles of bundle 5 at substantially halfway along the length of the bundle 5. The staple 30 may then be pushed into the opening of the housing 15 together with the bristles of bundle 5, thereby causing the bundle to fold in half and press

against the edge of the housing 15. The staple 30 may then be engaged as a force-fit inside the stem 4 of the applicator 3.

[0128] Another exemplary method of securing the bundle 5 to the housing 15 of the stem 4 may be to apply an adhesive, as shown in Fig. 32, and then to insert the bundle 5 by force into the stem 4 and/or to staple it therein. If the bundle is used to apply varnish, since the varnish V may contain a solvent suitable for dissolving a film of adhesive deposited on the bristles, the brush may be immersed in the varnish V contained in the receptacle 2 to dissolve the adhesive film away. Prior to applying the adhesive, the bundle 5 may be folded in half about the location of the staple.

[0129] Another packaging and applicator device for a substance in accordance with the invention is shown in Fig. 33. The device may comprise a receptacle 40 containing a substance P (e.g., mascara) for applying to eyelashes or eyebrows, and an applicator 41 comprising a stem 42 having a longitudinal axis X. The applicator 41 may comprise a brush 43 at one end and a handle member 44 at the other end. The handle member 44 may also serve to close the receptacle 40. The receptacle 40 may have a neck 45 with an outside thread so as to enable the handle member 44 to be screwed thereon.

[0130] The device may also comprise a wiper member 46 fixed inside the neck 45 so as to be used to wipe the stem 42 and the brush 43 as they leave the receptacle 40. The wiper member 46 in the example shown may comprise a flexible lip 47 defining a circular orifice of diameter corresponding substantially to the diameter of the stem 42.

[0131] The invention is not limited to a particular wiper member (and at least some embodiments could be used without any wiper member at all), but other wiper members known in the art may alternatively or additionally be used. For example, wiper members

comprising a block of foam and/or defining one or more optionally-flocked slots may be used alternatively or additionally.

[0132] In the example shown in Fig. 33, the stem 42 is rectilinear, however a curved stem may also be used without going beyond the ambit of the present invention. In addition, while the stem 42 is shown to be fixed relative to the handle member 44, it should be understood that the stem 42 may be movable relative to the handle member 44 by a suitable articulating member, such as, for example, a ball-and-socket joint.

[0133] The brush 43 may comprise a core 50 which may be made up of two or more metal strands twisted together. The core 50 may be fixed at one end to a housing in the stem 42 by, for example, force-fitting the core into the housing.

[0134] The brush 43 may also comprise bristles which are held between the twisted strands of the core 50 via, for example, clamping, as can be seen in Fig. 35. In Fig. 35, the core 50 is shown as seen from the side with the proximal end of the brush 43 being on the left and the distal end of the brush 43 on the right. In this arrangement, the brush may be said to be "twisted to the left." When the core 50 is twisted to the left, the branches of the core 50 may form turns which are seen to rise from left to right, when the brush is observed while it is in a vertical position with its end fixed to the proximal end of the stem 42 situated at the bottom and its free end (i.e., its distal end) situated at the top. An exemplary core that is twisted to the left is described in U.S. Patent No. 6,227,735. The invention may also be applied to brushes having a core that is twisted to the right, and to brushes having cores that are not twisted with the bristles being fixed, for example, by being stamped into the core, as described in European Patent Application EP A 1 155 637. The invention may also be applied to brushes having bristles that are fixed to the core by staples or by overmolding the core on the bristles. Other arrangements are also possible.

[0135] The bristles of the brush 43 may comprise undulating portions 20 which may be similar to those described above with reference to Figs. 2 to 12. The bristles of the brush 43 may also comprise periodic patterns as described with reference to Figs. 14 to 21.

[0136] The brush 43 may comprise an envelope surface defined by the free ends of the bristles. The surface may form a circular cross-section, as shown in Fig. 34, or a non-circular cross-section.

[0137] Figs. 37-47 show various exemplary embodiments, among other possibilities, of an envelope surface of a brush. For example, an envelope surface of a brush may have a substantially polygonal cross-section, such as, for example, substantially triangular cross-section (Fig. 37), substantially rectangular or square cross-section (Fig. 38), substantially pentagonal cross-section (Fig. 39), or substantially heptagonal cross-section (Fig. 40). In addition, an envelope surface may form a substantially oval cross-section, as shown in Fig. 41.

[0138] Figs. 42 and 43 show, among other things, a possibility of using the brush with at least one notch 55, which may form an outwardly concave shape as shown in the figures. The notch 55 may comprise a cross-section that is constant or changing along the brush. The notch 55 may be formed in a brush having a circular cross-section, as shown in Fig. 42, or in a brush having a non-circular cross-section, such as, for example, a substantially triangular cross-section, as shown in Fig. 43. In a brush having a triangular cross-section, the notch 55 may constitute a side of the triangle, in which case the brush may present a facet that is concave.

[0139] In another exemplary embodiment, it may be possible to make a brush with at least one substantially plane facet 44, as shown in Fig. 44. In still another exemplary

embodiment, it may be possible to make a brush with at least one indentation 57. In an embodiment shown in Fig. 45, the brush comprises three indentations.

[0140] Fig. 46 shows a variant embodiment of a brush having two indentations 57, and Fig. 47 shows another variant embodiment of a brush having only one indentation 57.

[0141] The brush may include a constant cross-section. The brush may also include a rectilinear core. The core 50 may also be centered or off-centered relative to the outline of the envelope surface when the brush is viewed in its cross-section. By way of example, Fig. 48 shows a brush with a core that is off-centered.

[0142] The bristles of a brush may be subjected to mechanical beating. Alternatively or additionally, the brush may be brought into contact with a treatment member comprising a heater element, for example while the brush is being driven in rotation, thereby imparting a permanent deformation to the bristles of the brush, as shown in, for example, Fig. 36. The brush may be rotated in either the clockwise or counter-clockwise direction. In various exemplary embodiments, the brush may be rotated in the direction opposite to the direction of the twist in the core.

[0143] The core 50 may be made by a variety of different methods. For example, the core may comprise a dual core made up of two or more individual cores 50' and 50", as shown in Fig. 49, that are twisted with respect to each other. Each individual core 50', 50" may comprise two strands that are twisted together to form a single core 50', 50" and that clamp onto bristles. It should be understood that any other suitable method known in the art may alternatively used to make the core 50, 50', 50".

[0144] The core may be made using one or more metal strands having a circular cross-section. The strands may optionally be sheathed.

[0145] In various other exemplary embodiments, the bristles may have a variety of cross-sectional shapes other than the circular shape. For example, bristles may have a cross-sectional shape of any one of the shapes shown diagrammatically in Figs. 50 to 66. That is, the cross-sectional shape of the brush may include, but be not limited to, a circular shape with a flat side (Fig. 50), a flat shape (Fig. 51), a star or cross shape (Fig. 52), a shape having three branches (Fig. 53), a U-shape (Fig. 54), an H-shape (Fig. 55), a T-shape ((Fig. 56), a V-shape (Fig. 57), a hollow circular shape (Fig. 58), a hollow non-circular or polygonal (e.g., triangular, square, pentagonal, or hexagonal) shape (Fig. 59), a shape that presents ramifications, e.g. a snowflake shape (Fig. 60), a solid polygonal shape, such as a triangular shape (Fig. 61), a square shape (Fig. 62), or a hexagonal shape (Fig. 63), an oblong shape, such as a lens shape (Fig. 64), or an hourglass shape (Fig. 65). It may also be possible to form bristles having portions that are hinged relative to one another, as shown in Fig. 66.

[0146] Where appropriate, the bristles may be subjected to a suitable treatment process for forming an end ball 61 (as shown in Fig. 67), an end fork 62 (as shown in Fig. 68), or a tapering tip (as shown in Fig. 69).

[0147] It may also be possible to form flocked bristles, as shown in Fig. 70. The bristles may be formed by extruding a suitable material (e.g., plastic material) containing a filler particles 63, so as to impart microrelief to the surface of the bristles, as shown in Fig. 71, and/or to confer magnetic or other properties thereon. The bristles may also be made out of a material having properties that facilitate sliding.

[0148] The bristles may be made of synthetic materials including but not limited to polyethylene, polyamides, such as PA6, PA6/6, PA6/10 or PA6/12, PA11, and Rilsan®; a Hytrel-Pebax; and other suitable thermoplastic polymers.

[0149] The invention is not limited to the examples described above. For example, implementation details of various embodiments and examples described above may be combined with one another.

[0150] The applicator may present three or more sets of undulating portions differing in pattern, diameter, and/or length.

[0151] The pattern of an undulating portion may not be a sinusoidal or sawtooth shape. In general, the pattern may have any shape that may be substantially described by any periodic function. Thus, the pattern of an undulating portion may also include a square wave shape, for example.

[0152] The applicator may not include undulating bristles. Instead, the applicator may include undulating teeth, as shown in Fig. 72, where two undulating teeth 110 may have different periodic patterns. These teeth 110 may be made by molding a plastics material together with a support 111. The support material and the material of the teeth may be identical or different from each other.

[0153] Throughout the description, including the claims, the expression "a" should be understood as being synonymous with "at least one" (i.e., relating to both the singular and the plural) unless otherwise specified to the contrary.

[0154] It will be apparent to those skilled in the art that various modifications and variations can be made to the structure and methodology of the present invention. Thus, it should be understood that the invention is not limited to the examples discussed in the specification. Rather, the present invention is intended to cover modifications and variations.